LSS[SM]

Legacy Site Services LLC

15 March 2007

Mr. Matt McClincy
Oregon Department of Environmental Quality
Northwest Region
2020 Southwest 4th Avenue, Suite 400
Portland, Oregon 97201-4987

Subject: Former Arkema Portland Plant
Responses to ODEQ/USEPA Comments on the Preliminary Draft Scoping Technical Memorandum
Groundwater Source Control Interim Remedial Measures
ECSI No. 398

Dear Matt,

This document provides responses to comments received from the Oregon Department of Environmental Quality (DEQ) and United States Environmental Protection Agency (USEPA) on 25 January 2007 and further discussed in the DEQ, LSS, ERM 8 February 2007 teleconference related to the December 2006 *Preliminary Draft Scoping Technical Memorandum Groundwater Source Control Interim Remedial Measures* (IRM), prepared by Environmental Resources Management (ERM) for Legacy Site Services LLC (LSS), agent for Arkema Inc. Each of the DEQ/USEPA comments is provided below in italic font, followed by LSS's response. As discussed and agreed to by DEQ, LSS does not intend to resubmit a revised scoping memorandum. It is envisioned that the following responses to comments, together with future deliverables as discussed below, will address DEQ/EPA comments.

<u>General Comments</u>

1. *EPA and partners identified the importance of interim reviews associated with the development of the groundwater model and the desire to participate in the review of the model. DEQ will develop with Arkema a more detailed schedule for the development of the groundwater model that identifies decision points and the opportunities for EPA partner review.*

   See Response to DEQ Appendix A General Comment.

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Specific Comments

1. *Section 1.1 Interim Remedial Measure Objectives, First Bullet, Page 2 – The referenced text states that one of the objectives of the IRM is to "Prevent migration of groundwater COPCs in excess of their respective Maximum Contaminant Levels (MCLs) (or alternatively risk-based concentrations) ... to the Willamette River". This objective needs to be expanded beyond MCLs to include contaminant levels in excess of concentrations that would result in unacceptable risk to ecological receptors or humans either from direct or indirect exposure in the river environment per the remedial action objectives of the EPA and Arkema Administrative Order on Consent for Removal Action.*

   As noted in the Scoping Technical Memorandum, it is LSS's intention to perform an evaluation to develop risk-based screening levels which would be protective of human and ecological receptors. LSS will consider these concentrations in design of the Groundwater Source Control IRM. As requested by DEQ, LSS will present the proposed approach for developing these risk-based concentrations as part of the Joint Source Control Strategy Screening (JSCS) for those constituents that either do not have an MCL or after the weight-of-evidence evaluation, require a risk evaluation in order to determine relevant and appropriate remedial goals. It is envisioned that the Joint Source Control Screening Evaluation will be submitted in advance of the Focused Feasibility Study (FFS). Note that in the JSCS evaluation, the exceedance of one or more JSCS screening levels will be used to identify areas that require further weight-of-evidence evaluation not necessarily areas of unacceptable risk, since the JSCS screening is not a risk assessment. It should also be noted that the JSCS weight-of-evidence evaluation, in accordance with DEQ's direction, will be focused on the areas/constituents that are beyond the boundaries of the proposed groundwater Source Control IRM hydraulic capture zone. LSS agrees with ODEQ's suggested approach, as evaluation of COPC's which are within the proposed capture zone of the Source Control IRM would provide no data of value pertaining to the evaluation of risk to ecological and human receptors from either direct or indirect exposure in the river environment.

2. *Section 1.1 Interim Remedial Measure Objectives, Page 2 - Add as the last bullet, the following objective: Select and implement an IRM compatible with the early in-water removal action so that the early in-water removal action is not limited in scope by the IRM.*

   As the in-water removal action has not yet been defined, it is not possible to select a "compatible" remedy. However, in the evaluation and scoping of options for the Groundwater Source Control IRM, LSS will consider as part of the FFS, a reasonable range of in-water improvements and will evaluate the potential compatibility of the groundwater source control alternatives with that reasonable range of improvements.

3. *Section 2.2 Previous Remedial Actions, Page 4 – The last paragraph does not accurately reflect that some of the innovative technologies may not achieve treatment in an appropriate time frame for the early in-water removal action. Revise it to read: However, the longer*

time required for these in situ technologies may limit their use within the confines of the early in-water removal action (i.e., in-water Engineering Evaluation /Cost Analysis [EE/CA]) schedule. The technology selected needs to be consistent with both the stated groundwater source control objectives and the early removal action schedule.

LSS agrees that in situ technologies, by their nature, are not capable of meeting the aggressive source control schedule. As stated in Section 2.4 of the *Scoping Technical Memorandum*, "LSS does not currently believe an in situ remedial approach will be capable of meeting the source control objectives in the USEPA-envisioned timeframe. In situ treatment technologies, by their nature, are constrained by reaction kinetics and media interferences which alter their ability to meet rapid and undefined groundwater source control objectives." Therefore, LSS believes this comment has already been addressed in the *Scoping Technical Memorandum.*

4. *Section 2.3 Joint Source Control Strategy and Screening, Last Sentence, Page 5 – Change the last sentence to read: Once finalized, the Source Control Screening evaluation will determine the areas of the site requiring active source control to achieve upland and in-water objectives, or areas of the site requiring further consideration (e.g., site-specific risk evaluations and contaminant fate and transport simulations) for upland groundwater source control.*

   Comment noted. The Source Control Screening will determine the areas of the site outside of the proposed groundwater Source Control IRM capture zone requiring further consideration (e.g., site-specific risk evaluations and contaminant fate and transport simulations) for upland groundwater source control.

5. *Section 2.3 Joint Source Control Strategy and Screening, Last Paragraph, Page 5 – Any areas requiring additional evaluation beyond the weight-of-evidence evaluation conducted in the Source Control Screening need to be identified in the Source Control Screening. DEQ and EPA will need to agree with the proposal (methodology and schedule). Ideally, the areas requiring active source control will be clearly defined prior to Arkema conducting the focused feasibility study (FFS).*

   Comment noted and agreed. The strategy (methodology and schedule) for performing further evaluations (e.g., risk evaluations and/or contaminant fate and transport simulations) for those areas beyond the proposed capture zone of the groundwater Source Control IRM will be presented in the Source Control Screening.

6. *Section 3.0 Conceptual IRM Approach and Layout, Page 6 – DEQ understands that the Arkema team has concluded that a containment barrier wall located at the top of the bank is the most feasible option and achieves the source control objectives. However, the FFS needs to initially evaluate the optimum location for the wall (e.g., top of bank versus toe of bank) to achieve both the early in-water removal action and the upland IRM source control objectives. For example, in the Acid Plant Area a significant contaminant source area (stranded wedge) would remain riverward of a top of bank containment wall. Since it may*

not be feasible to remove this stranded wedge as part of the early in-water removal action, the FFS needs to evaluate options for a wall in the Acid Plant Area both at the toe of the bank and at the top of the bank.

The Arkema team has indicated that they question the feasibility of constructing a wall at the toe of the bank in the Acid Plant Area. The FFS will need to balance the feasibility of construction with the impact on the ability to meet the in-water removal action objectives. In general, the wall should be located and constructed to allow the opportunity for the maximum removal of in-water and riverbank principle threat material and minimize the potential for sediment recontamination.

As requested, the FFS will evaluate barrier walls placed at both the toe and top of the slope. Both alternatives will be evaluated against the DEQ's feasibility study balancing factors, including implementability and effectiveness. However, as information further rationale for locating the barrier wall at the top of bank is presented below.

As stated in the Scoping Technical Memorandum, LSS has serious concerns not only about the constructability of a barrier wall at the toe of the slope, but also about its effectiveness. Not least of LSS's concerns is that, under a toe-of-bank scenario, the water level of the river would be above the wall during all but the lowest river stages. Thus, water would effectively constantly flow over the top of the wall and seriously compromise, or negate, efforts to create upland hydraulic capture.

It is also noted that placement of the barrier wall at the top of the slope may actually be more compatible with removal of in-water principal threat material (subject to final definition) than placement at the toe of the slope. A barrier wall placed at the toe of the slope will limit the depth to which removal could be performed along the length of the barrier wall and would complicate any potential dredging efforts. For example, for a slurry wall, removal of the top of the wall as part of dredging would increase the flow of water over the wall, further compromising upland hydraulic containment. For a sheet pile wall, dredging along the length of the wall would be more difficult due to the physical obstruction presented by the sheet piling. Additional complications would arise due to the need for construction of a pad along the toe of the bank sufficient to accommodate the barrier wall installation equipment.

Conversely, placement of the barrier wall at the top of the slope would allow future improvements to the river bank. For a slurry wall, the top portion of the wall (above the high water table) could simply be removed, to the extent necessary, as it does not provide any hydraulic containment benefit. A sheet pile wall would provide vertical shoring up against which an excavation, to the extent beneficial or required, could be performed.

The FFS will discuss the "stranded wedge" of impacted soil and groundwater (that is the area between the barrier wall and the river) under a top-of-bank barrier wall scenario. It should be noted that the barrier wall and groundwater extraction system will essentially cut off ground water migration through the potentially affected media on the river side of the barrier wall. Therefore, the mobility of constituents potentially in the soil on the river side of the barrier wall will be greatly reduced, despite not being on the containment side of the barrier wall. Several possible remedies exist for dealing with this area (e.g., insitu stabilization/oxidation/reduction , active capping, traditional capping, removal, monitored natural attenuation, etc.) and will be discussed in the FFS and/or the EE/CA, as appropriate.

7. *Section 3.0 Conceptual IRM Approach and Layout, Page 6 – As noted in review comment # 1, additional risk based contaminant levels beyond MCLs need to be considered. The potential for recontamination of sediment via the groundwater migration pathway also needs to be carried forward unless it is documented that alternative concentrations such as MCLs are protective for this remedial action objective.*

   See response to comment 1.

8. *Section 3.1 Containment Barrier Wall, Page 6 – Additional discussion and logic is requested in this section regarding the statement that the "barrier wall will not completely encompass the upland source ..." It is unclear why Arkema would not want to reduce the influence of up gradient groundwater and subsequently the volume of water behind the wall which must be pumped and treated.*

   It is LSS's position that hydraulic containment can be achieved with or without a fully-encompassing barrier wall. Assuming each configuration is technically feasible (i.e., the volume of generated water associated with each configuration can be treated and managed successfully), then the balancing factor becomes reasonableness of cost. Although this option has not been completely eliminated from consideration, it is LSS's assertion that a fully-encompassing barrier wall scores very low on the "reasonableness of cost" balancing factor. Based on information to date, the capital costs of a fully encompassing barrier wall do not appear to warrant the possible benefits of a reduction in flow volume. Examples of factors that could make a fully-encompassing barrier wall more reasonable include large incremental increases in capital and/or O&M costs associated with a non-encompassing barrier wall or technical impracticability issues identifying a viable management option for treated water.

9. *Section 3.1 Containment Barrier Wall, Page 6 – The design study provides for hydrogeologic studies and modeling to support the wall design. These efforts will need to focus on the hydraulic properties of existing silts and demonstrate they are acceptable as a containment barrier. The FFS should consider alternatives should the silt layer be inadequate to fully control groundwater flux in the IRM area.*

   One objective of the groundwater barrier wall is to provide an adequate barrier to groundwater infiltration from the river into the area with potentiometric level lowered by the groundwater extraction system so that the system can provide capture at the lowest extraction rate possible. While keying into the relatively low permeability silt layer will have the benefit of reducing the rate of infiltration, the permeability of the silt will not directly affect the ability of the system to create hydraulic containment. The permeability of the deep silt will, however, impact the rate at which groundwater must be extracted to create the necessary containment.

As discussed in the scoping memorandum, it is LSS's intention to install the barrier wall down to the deepest extent technically practicable (i.e., the top of the Columbia River Basalt [CRB]).

Based on the points above, LSS believes collection of additional focused hydraulic conductivity data of the silt layer(s) will not impact the eventual design of the barrier wall system and therefore is not necessary.

10. *Section 3.1 Containment Barrier Wall – The FFS needs to establish the high water design criteria for the containment barrier wall for the purposes of identifying the top of wall elevation and depth to basalt.*

    The FFS will identify combinations of design land- and river-side ground water elevations that will be used during the design process. However, the top of the barrier will be at or near the current ground level, regardless of the barrier wall type (i.e., slurry or sheet-piles).

    It is noted that if the barrier wall is constructed at the toe of the bank as suggested in comment 6, the water elevation would frequently be above the top of the barrier wall, thus compromising and negating any attempts at upland hydraulic containment.

11. *Section 3.1 Containment Barrier Wall – The FFS needs to consider the associated volume and management of bank soil as part of the evaluation of the various wall/location options.*

To the extent soil will be excavated in the riverbank area during barrier wall clearance and construction activities, spoils management will be considered in the FFS. Proposed procedures for soil management include the following:

- Soil excavated from the barrier wall (sheetpile or slurry) pre-construction clearance trench will be returned to the excavation. Large debris obstructions will be characterized and disposed of at a suitable disposal facility.
- If a slurry wall is selected as the barrier wall technology, spoil from the slurry trench excavation will be mixed with slurry and, if necessary with imported fine soil, to produce the required low-permeability soil-slurry backfill. Excess excavation spoil will be solidified and either placed as cover over the barrier wall or characterized and disposed of at a suitable disposal facility. Excess slurry will be consumed by mixing with native soil in relatively short extensions of the barrier wall. These volumes will be better defined as part of the soil slurry compatibility testing and design phases.
- If a sheet-pile wall is selected as the barrier wall technology, spoil will not be generated.

12. *Section 3.1 Containment Barrier Wall, Page 7 – As noted in review comments # 4 and # 5, the Source Control Evaluation will identify the groundwater areas to be considered in the FFS for active source control. DEQ and EPA need to agree with the scope and schedule for*

any proposed site-specific evaluation that would limit the scope of groundwater source control.

See responses to comments 4 and 5.

13. *Section 3.2 Hydraulic Containment System, Page 7 – How will the hydraulic containment be evaluated (e.g., compliance wells, modeling, etc.)?*

    Design of the hydraulic containment system will be accomplished using groundwater modeling and hydraulic data from groundwater elevation monitoring and previous groundwater pumping tests. During operation of the containment system, hydraulic containment will be evaluated using groundwater elevation measurements from key monitoring wells/piezometers to assess whether hydraulic containment is being achieved. Groundwater elevation data will be utilized to prepare elevation contour maps, which will be the primary tool to assess hydraulic containment.

14. *Section 3.3 Other Considerations, Page 8 – DEQ has indicated that it expects that the pending Hot Spot Evaluation will determine that the fill between the former DDT process waste pond and the river bank in the Acid Plant Area will be a soil hot spot. In order to avoid a conflict between the groundwater IRM and the future upland record of decision the FFS needs to consider the Acid Plant riverbank fill as a hot spot and evaluate the compatibility of the removal or treatment of this fill with the containment barrier wall options. The object of the FFS will be to identify both a preferred groundwater and riverbank fill remedial option.*

    Although the fill between the former DDT process waste pond and the river bank may be a Hot Spot, the Hot Spot Evaluation process has not yet been completed and therefore it has not yet been determined if the riverbank fill area is indeed a Hot Spot. Upland soil hot spots, following their identification and confirmation will be addressed in the full FS for the uplands.

15. *Section 3.3.2 Cleanup Goals, Page 8 – See earlier comments on the adequacy of MCLs and process for conducting site-specific evaluations (i.e., review comments # 1, 4 and 5).*

    See responses to comments 1, 4, and 5. It should be noted that the goal for this IRM as stated in Section 3.3.2 is to provide hydraulic control .

16. *Section 4.1.1 Groundwater Modeling, Page 10 – Add the following sentence to the end of the second paragraph. Each phase will potentially include technical review in coordination with ODEQ, EPA and partners.*

    Comment noted and agreed.

17. *Section 4.1.3 Laboratory Treatability and Compatibility Studies, Page 11 – The first bullet notes that samples will be collected from both major groundwater plumes. As there are more than two and overlapping groundwater contaminant plumes please clarify.*

The two groundwater plumes referred to in the scoping memorandum are 1) the monochlorobenzene (MCB)/pesticide plume located primarily in the former Acid Plant Area and 2) the hexavalent chromium (Cr[VI])/perchlorate/chloride plume located primarily in the former Chlorate Plant Area. The sampling plan is clarified below.

Groundwater samples for groundwater treatability studies will be collected from selected monitoring wells across the site. These selected well samples will be blended together in order to provide a representative blend of expected influent concentration to a full-scale treatment system. In order to expedite the project, laboratory treatability studies will be performed largely in parallel with groundwater modeling. As such, the monitoring wells selected for groundwater sample collection may not be fully representative of full-scale influent. Therefore, in order to bracket the potential variability in influent concentrations, treatability study samples will also be run at a higher, more extreme blended concentration (biased high), so that the treatability studies will still provide sufficient data for evaluating the performance of the various treatment technologies.

Samples collected for the slurry compatibility testing will be used to simulate a "worst case scenario" for compatibility between a potential slurry wall and site soil/groundwater. Therefore, for the slurry compatibility test samples will be collected from the wells containing the highest concentrations of site contaminants.

Both the sample collection rational and procedures for the groundwater treatability and slurry compatibility tests will be described in more detail in the scopes of work to be submitted to the agencies.

18. *Section 4.1.3 Laboratory Treatability and Compatibility Studies, Page 11 – This section infers that the FFS is assuming only slurry wall technology, whereas Section 3.1 indicates a comparative analysis of sheet pile and slurry wall. Please clarify.*

Section 4.1.3 is not intended to presume the barrier wall will be a slurry wall. The compatibility study described in the scoping memorandum is designed to 1) provide valuable data for the evaluation of slurry wall technology in the FFS, and 2) aid in the design of a slurry wall should that technology be selected as the preferred alternative. Treatability and compatibility studies are being performed prior to the selection of a preferred alternative at the request of the DEQ.

19. *Section 4.1.4 Focused Feasibility Study, Page 13 – To facilitate EPA and partner review, DEQ will identify the number of draft FFS copies and recipients for distribution.*

Comment noted and agreed.

20. *Section 4.1.5.1 Draft Design, Page 14 – Include in the draft design document the site/construction restoration standards and approaches to be used. Also, temporary sediment and erosion controls will be a critical element of the construction and should be discussed in the design criteria memo.*

Comment noted and agreed. The FFS will include a description of the site/construction restoration standards and temporary sediment and erosion controls for the recommended groundwater IRM.

21. *Section 4.1.6 Permitting, Page 17 – Considering the magnitude of this action, a ARARs analysis is warranted and should be addressed in this section. While the three listed permits may be pursued, the extent of regulatory compliance needs to be evaluated through a ARARs process.*

    Comment noted and agreed.

22. *Section 4.1.7 Installation, Startup, and Operation and Maintenance, Page 17 – This section references dry season construction. The construction schedule needs to accommodate the in-water removal action. This section should reference the in-water removal action and discuss how implementation will tie to the in-water work schedule.*

    As shown on Figure 4-2, implementation of the groundwater IRM is planned for Summer 2009 and the EE/CA removal action is planned for Winter 2010. Therefore, it is not expected that implementation of these two actions will overlap. In the event that overlap is expected, LSS will notify the agencies of plans to synchronize the work.

23. *Section 4.1.7 Installation, Startup, and Operation and Maintenance, Page 17 – Add to the text that both the EPA and DEQ will be involved in construction observation and monitoring.*

    Comment noted and agreed. LSS expects ODEQ and EPA will use best efforts to coordinate with each other to minimize duplication of work.

24. *Section 4.1.8 Source Control Implementation Report, Page 18 – As noted on Section 3.2, how will the hydraulic containment be evaluated (e.g., compliance wells, modeling, etc.)?*

    See response to comment 13.

25. *Section 4.1.8 Source Control Implementation Report, Page 18 – This section states that the source control implementation report will be the sole report pertaining to the source control evaluation. While DEQ agrees with this statement in principle, it is certainly possible that separate evaluation/reports may be required as part of a follow up weight-of-evidence evaluation, for on-going performance evaluation of the effectiveness of source control measures and other issues that are not apparent at this time.*

    Comment noted and agreed.

26. *Section 5.0 Identification of Remedial Technologies for Evaluation, Page 20 – Because the groundwater IRM is a critical element of the overall site remedy, the FFS needs to evaluate all 5 of DEQ's feasibility study balancing factors identified in Oregon Administrative Rules*

OAR 340-122-0090 (i.e., effectiveness, long-term reliability, implementability, implementation risk and reasonableness of cost).

Comment noted and agreed.

27. *Section 5.0 General Comment, Page 20 – There appears to be an absence of discussion about stormwater (outfalls to abandon), excavation control (how to install the wall), soils management (contaminated excavation spoils), and wall alignment (analysis to select a preferred alignment). These factors should be identified at this point in the planning process.*

    - Storm Water Outfalls - All pipes, including storm water outfalls, that cross the route of the groundwater barrier wall will be located, cut, and plugged clear of the crossing as an initial step of construction.

    - Excavation Control - The construction techniques used to construct each of the alternative barrier wall technologies will be described in detail adequate to facilitate evaluation of alternatives in the FFS. The recommended barrier wall technology will be described in more detail in the FFS. As discussed in the scoping memorandum, a geotechnical engineering evaluation will be performed to evaluate slope stability and excavation safety during and after construction.

    - Spoils Management - See response to comment 11.

    - Wall Alignment – While the area of the site requiring source control will be identified in the Source Control Screening, the specific wall alignment will be identified in the FFS and will be based on:
        - Extent of the area to be hydraulically controlled;
        - Results of site-specific ground water model;
        - Results of the geotechnical evaluation and slope stability analysis; and
        - Practical limitations of surface topography, construction methods, and other site limitations.

28. *Section 5.1 Constituents of Potential Concern, Page 20 – DEQ agrees that the Source Control Screening evaluation will be the initial basis for defining COPCs. See previous review comments # 1, 4, 5 and 12 as they relate to this topic. DEQ anticipates that dioxins/furans will be included in the COPC list. Arkema also will need to confirm that the COPCs identified address the remedial action objectives identified in the EPA/Arkema Order.*

    Based on current groundwater data in the chlorate and acid plant areas in conjunction with the proposed capture zone of the groundwater Source Control IRM, LSS believes that the low level dioxin/furans in groundwater potentially pertaining to Arkema operations will be adequately addressed. Should the JSCS screening evaluation of those areas beyond the proposed capture zone of the groundwater Source Control IRM reveal dioxin/furan at COPC concentrations, then LSS expects ODEQ and EPA will notify the appropriate responsible party and seek source control measures with the appropriate responsible party. See attached LWG Comprehensive Round 2 Site Characterization Summary and Data Gaps Analysis Report , Map 5.1-1e.

29. *Section 5.2 Containment Technologies, Page 21 – As noted in review comment # 6, the wall may be more optimally placed upland or riverward depending on several factors. It may also provide a structural feature that could limit or enhance the effectiveness of the in-water action. DEQ and EPA will consider how the application of the barrier wall technology detracts or supports the effectiveness of the in-water action.*

    See response to comment 6.

30. *Section 5.2 Containment Technologies, Page 21 – Add the following bullet in the second set of bullets: Compatibility with early removal action activities such that these activities are not limited in scope by the IRM.*

    Comment noted also see response to Comment 2.

31. *Section 5.3 Ex Situ Groundwater Treatment Technologies, Page 22 – The FFS needs to include a discussion of the presence of chloride levels in groundwater and identify groundwater treatment and management options.*

    Management options for handling treated water with elevated concentrations of chloride will be evaluated in the FFS. However, treatment of extracted groundwater for chloride (i.e., desalinization) has been screened out of consideration at this stage for several reasons:

    1. The combination of high chloride levels and low volume of water does not lend itself to using current desalinization technologies designed for low strength and high flow. Even if the concentrations and flows were suitable, constructing and operating a desalinization plant is not technically practicable; and
    2. It is LSS's expectation that a technically practicable water management option capable of handling the chloride concentrations observed at the site without chloride specific treatment can be identified.

32. *Section 5.3 and Section 5.4 Water Handling Options – The FFS needs to include a discussion of applicable federal and state hazardous waste laws and factor this into the various treatment and waste handling options.*

    Comment noted. However, while it is possible that groundwater treatment processes may generate materials (sludges) that may be characterized as hazardous waste, LSS does not expect that extracted groundwater will classify as hazardous waste. As noted in Comment 21, LSS will perform an ARAR evaluation.

33. *Section 5.4 Water Handling Options, Page 23 – DEQ approval of discharge of highly concentrated waste streams, even if low in volume, to the public owned treatment works*

conveyance system (i.e., sanitary sewer lines) is unlikely given the likelihood of leakage from the system.

Comment noted. Under this water management option, it is assumed treatment of the extracted groundwater would be provided in order to comply with applicable discharge limits established by the publicly owned treatment works (POTW).

34. *Figures - Summary figure(s) from the Source Control Evaluation which identify the groundwater area that requires active source control need to be included in the FFS.*

    It is assumed that the area proposed for hydraulic control as part of the groundwater Source Control IRM will capture the portions of the Arkema plumes that require active source control. Maps of these plumes are already available in the RI Report. In addition, the Figures that will be generated from the groundwater portion of the JSCS evaluation will also show COPCs inside the proposed capture zone. However as stated in other responses to similar comments, the focus of this effort is on COPC's which are outside the area of proposed active groundwater management.

35. *Table 4 – The table should have another line that covers sheet pile chemical compatibility issues.*

    Compatibilities of commercial manufacture metals with chlorinated hydrocarbons (such as MCB), chlorides, and other primary site COCs are well known. Therefore, the evaluation of compatibility of sheet pile materials will be based on commercial product compatibility tables.

36. *Table 5-1 – The section on Sealed-Joint Steel Sheet Pile Wall should include all the key items from the previous line, Conventional Sheet Pile Wall, since many of those items are part of the Sealed-Joint Sheet Pile.*

    Comment noted and agreed.

<u>Appendix A - Appendix A Groundwater Modeling Scoping Technical Memorandum</u>

DEQ and EPA comments on Appendix A are presented separately.

DEQ Review Comments

General Comment

1. *The model should be developed in stages, documenting the bases for selecting specific modeling approaches, assumptions, parameter values, etc along the way. The existing document doesn't have sufficient detail for DEQ to approve anything other than Arkema's choice to use a numerical model. Arkema will need to break the model down and do a thorough job of justifying the framework, assumptions and parameter values it uses and the scenarios it simulates.*

a. Possible Stages: I) Model framework - hydrogeologic setting and conceptual model, selection of model domain, boundary conditions, parameter values II) calibration and verification work methods and outcomes, III) predictive simulations for source control alternatives

b. The document should include specific citations and references for parameter values (i.e. hydraulic conductivities for each layer, which geologic borings were used to construct grid layers), and rationale for modeling assumptions (i.e. basis for assuming contact between overlying alluvial sediments and Columbia River Basalt (CRB) is a no-flow boundary).

c. A schedule for interim reports and corresponding comment periods should be developed to ensure there is consensus at each stage.

Based on agency comments and the teleconference between LSS, ERM, and DEQ on 8 February 2007, LSS proposes the following framework for agency review of the groundwater model:

1. Model Framework – Information to be reviewed by agencies includes:
    a. *Groundwater Modeling Scoping Technical Memorandum* (Appendix A of the scoping memorandum for the groundwater IRM);
    b. Figures depicting model extent, conceptual model layers, groundwater elevations, and geologic surface elevations (included as Appendix A of these responses to comments); and
    c. Tables presenting proposed parameter values and water levels (included as Appendix A of these responses to comments).
2. Model Results and Calibration – Information to be reviewed by agencies includes the modeling summary report (discussed in Section A.8 of the scoping memorandum) and an electronic copy of the groundwater model. LSS proposes a face-to-face meeting upon completion and review of the model to discuss agency comments.
3. Simulations for Source Control Alternatives – Results of these model simulations will be integrated into the FFS and will be submitted concurrently with the FFS.

The groundwater IRM project schedule (Figure 4-3) has been revised to reflect the review periods above and is attached to these responses to comments.

Specific Comments

1. *Although, calibration of the groundwater model during late summer makes sense to exclude a complicating factor such as precipitation recharge, Arkema will need to also model worse-case conditions regarding hydraulic control, (high precipitation - see comment 3, high gradient periods). There should be an analysis of groundwater elevation - river stage to determine when highest extraction rates would be required.*

The groundwater model will be calibrated to water level measurements made during January 2007. These water level measurements were obtained for calibration of the model to groundwater conditions at the site during a high precipitation period. Water level measurements have also been collected from the site in the past during low precipitation periods in the summer months. These water level measurements will also be used to calibrate the model to groundwater conditions during low precipitation periods.

2. *No flow boundary at CRB interface needs greater justification.*

   The lower boundary of the model grid will be a no-flow boundary. This boundary represents the bottom of the unweathered CRB in the model, not the interface with the CRB and the overlying deep alluvial sediments. Downward groundwater flow from the unweathered basalt is assumed to be negligible as a simplifying assumption of the model design.

3. *There should be additional support for recharge assumptions regarding both the total annual recharge and how it's distributed over the year. A careful accounting of site surfaces to estimate percent paved/percent area for direct infiltration, surface runoff is probably warranted.*

   The initial recharge used in the model will be based on the recharge rates presented in the United States Geologic Survey (USGS) report on estimated groundwater recharge, base flow, and stream reach gains and losses in the Willamette Basin. This reference was provided to LSS by DEQ. This recharge rate may be adjusted, as necessary, during model calibration.

4. *Discuss whether utility interception and infiltration (I&I) has a significant effect on water mass balance.*

   The effects of utility interception and infiltration will be evaluated during model calibration.

5. *Figures showing model domain and boundaries are needed.*

   A figure showing the model grid and location of the flow boundaries in the model is included in Appendix A.

6. *A discussion of what evidence or criteria will be used to demonstrate sufficient capture and hydraulic control. Monitoring wells which are going to be used for this demonstration need to be identified.*

   See response to comment 13. Monitoring wells (either new or existing) which will be used to demonstrate capture will be identified in the FFS and design stages.

7. *The RI defined 5 hydrogeologic layers while the scoping document identifies breaks out a sixth (weathered basalt). Is there sufficient information to characterize this layer?*

   LSS is proposing to use seven groundwater model layers as depicted in Figure A-5 in Appendix A. These seven layers have been developed not only to be consistent with the local geology on the Arkema site, but also to reflect variability in the geology across the model extent. A highly fractured and weathered zone at the top of the basalt bedrock has been observed in several well borings at the site and on adjacent properties. One well on the main portion of the LSS site (MW-21b), five wells on Lots 1 and 2, and several wells on the SLLI site are screened in this zone. A pumping test was also performed on MW-21b to estimate the hydraulic conductivity of the fractured and weathered zone in the basalt bedrock. These data have been included in the groundwater model.

8. *There needs to be a discussion of vertical gradients in site hydrogeological conceptual model.*

   A discussion of the vertical hydraulic gradients at the site will be included in the conceptual model and will be incorporated into the model design. Estimates of vertical hydraulic gradients can also be found in the RI Report (ERM 2005).

9. *It appears the Doane Lakes are modeled as having no surface water inputs - is this justified? Discuss hydrology of lakes further.*

   The interaction between the Doane Lakes and the underlying shallow groundwater flow zone is dependent on the difference between the water levels (head) in the lakes and the shallow groundwater zone and the permeability of the underlying soil unit. North Doane Lake and West Doane Lake will be represented in the model as constant head boundaries, which will simulate the interaction of the lakes with the shallow groundwater flow zone. The water level elevations in the river boundaries will be set at the lake elevations measured by AMEC (2005) or more recent measured elevations, if available. The surface water inputs to the lakes are irrelevant, since measured water level elevations for the lakes are available.

10. *How are geologic conditions interpolated by the model between boring locations?*

    The geologic conditions between soil and well boring will be interpolated using 2D kriging.

11. *Appendix A Section A2 – Include the following text at the end of the paragraph.*

    Technical reviewers will have the opportunity to review the development of model design, input parameters, procedures used to construct and calibrate the model, methods used to apply the model to the site-specific environmental problems and results of the model simulations prior to issuance of the summary modeling report and/or inclusion of output from model runs in other related documents. These interim reviews will be coordinated with DEQ, EPA and partners to help meet the stated objectives of the groundwater model.

    See response to DEQ Appendix A general comment 1.

12. *Appendix A Section A4.1 – The referenced text states that groundwater model domain will encompass neighboring sites include "GATX". DEQ assumes that Arkema meant GASCO.*

The GATX site is not the GASCO site; it is the Willbridge Bulk Fuel Terminal site (also known as Kinder Morgan Fuel Terminal site).

13. *Appendix A Section A.8 – Particle tracking model outputs are a useful tool to show the extent of hydraulic containment.*

    Particle tracking simulations will be performed, as appropriate, to determine the extent of hydraulic containment as part of the evaluation of source control alternatives.

EPA Review Comments

1. *The use of a three-dimensional model seems acceptable, but there needs to be some commitment to having, or installing, sufficient monitoring wells to make the model functional with sufficient data points. If the facility assumes that there are sufficient data points, including wells at multiple zones, then those should be provided in table and map form.*

   There are more than 100 groundwater monitoring wells installed on the Arkema property which provide comprehensive coverage of the various water-bearing zones at the site. These wells and the zones in which they are screened are summarized in Table A-1 in Appendix A. Geologic data is also available from many of the wells installed on adjacent properties and these data will be used to develop the groundwater model. LSS believes that there are sufficient data from the site and from the adjacent properties to develop a useful and functional groundwater model. The data used to design and construct the model will be provided to the agencies during the model review process, and will be included in a report summarizing the model design and calibration.

2. *The model should also be calibrated for both the low precipitation (low infiltration)/low river stage season, and also for a high precipitation (high infiltration)/high river stage period.*

   See response to DEQ Appendix A Specific Comment 1.

3. *Appendix A Section A.1. The use of the ASTM guidelines for groundwater modeling may be acceptable, but it is suggested that the EPA Region 10 modeling guidelines, which are attached, be covered as well since EPA has not reviewed or approved the ASTM guidelines and they may contain issues that do not meet EPA needs.*

   The groundwater model will be developed in accordance with ASTM and EPA Region X guidelines for groundwater modeling, and generally accepted industry practice. It should be noted that the ASTM guidelines were developed with funding from EPA as part of a cooperative agreement between EPA, the USGS and the U.S. Navy.

4. *Appendix A Section A.3.2.2. While the report does state that "simulations will be solved using a total variation diminishing (TVD) method for solution..." and "MT3DMS is a third-order TVD method with a universal flux limiter", these statements are not sufficient explanations to those not very familiar with the models, and therefore, these statements need to be translated into more comprehensible statements for the non-modeler. What is important about these methods? How will they improve the modeling results?*

   MT3DMS has several different solution methods. The TVD method is currently the most accurate solution method provided for this model code. The TVD method minimizes numerical dispersion and artificial oscillation, the two major types of error in transport model concentration solutions as described in Section A.3.2.2 of Appendix A of the scoping memorandum. This scoping memorandum is, by necessity, technical in nature and was prepared for ODEQ and/or persons familiar with groundwater modeling. LSS believes that EPA has in-house capabilities similar to those available at ODEQ that are familiar with models. LSS understands that this comment was provided to EPA by a contractor that apparently does not possess modeling capabilities. As such, LSS does not believe that this is an appropriate comment. LSS reserves its rights to contest any response costs associated with this EPA contractor's review and comment on Upland work.

5. *Appendix A Section A.3.3.3. The plan states that the model will be constructed with "Groundwater Vistas™, a computer-aided design program.... ". It is unclear if the agencies will be provided with copies of this code to use independently, or what options will be available for the agencies to request special runs with different parameters, and different views of outputs. Please explain how these issues will be worked out since they are critical to acceptance of the modeling proposed.*

   Groundwater Vistas™ is a computer-aided design (CAD) program for constructing groundwater models using different groundwater model codes. It is not a model code and a copy of Groundwater Vistas™ is not needed to run the models constructed with this CAD program. A free unlicensed copy of Groundwater Vistas™ can be downloaded from the developer's web site that can be used as a viewer to examine the model design and input parameters. Copies of the model code input files will also be provided to DEQ and EPA, which can be imported to other groundwater modeling CAD programs to run the model with different parameters or to create different views of the model outputs.

6. *Appendix A Section A.4.2. The statement "storage coefficients specified for these model layers may alternate between confined and unconfined values during the model simulation period" and needs to be explained in more detail since it is not obvious to the reviewers.*

   The use of this layer type in MODFLOW allows groundwater flow conditions in a model layer to change from confined to unconfined during the course of a model simulation. This situation would occur when pumping from a well in a confined layer lowers the water level around the well to an elevation below the top of the model layer. This layer type allows for more accurate model solutions in pumping simulations.

7. *Appendix A Section A.4.3. Boundary conditions second and third bullets. Overall the proposed conditions seem reasonable. The exceptions are the constant-head SW and NE margins of the model grid, and also the no-flow boundaries of NW and SE margins of the model. Please explain why the constant head and no-flows at those boundaries.*

   The NE and SW margins of the model are approximately perpendicular to groundwater flow and parallel to piezometric surfaces along the upgradient and dowgradient margins of the model. These margins are set as constant-head boundaries to simulate the approximate consistent piezometric surfaces observed upgradient of the site (i.e., along the SW margin) and at the Willamette River downgradient of the site (i.e., along the NE margin). The NW and SE margins of the model grid are approximately parallel to the direction of groundwater flow. Therefore, there is no significant groundwater flow across NW and SE margins of the model grid and these margins of the model grid will be appropriately represented as no-flow boundaries in the model design.

8. *Section A.5.2. The use of an initial recharge of 1 inch where the precipitation per year is 37 inches is not convincing or clear. Secondly, the model should also be calibrated to a wet season when most of the precipitation, and the resultant hydraulic driving forces will be in play at the site. The use of calibration to the fall season levels is not acceptable since it ignores the major recharges to the site and the entire model domain. Please consider another calibration during the wet season and with a much higher recharge rate, perhaps 20 to 25 inches recharge, or fully document why another value is used and support it with some references for infiltration rates.*

   See responses to DEQ Appendix A Specific Comments 1 and 3.

9. *Appendix A SectionA.5.3. Please provide constant head boundaries at the river for the dry and wet periods, similar to the issues in previous section.*

   The specific water elevations that are used for the constant-head boundaries in the model will be provided in a report summarizing the model design and calibration.

10. *Appendix A Section A.6.1. The calibration states that "successive simulations until the steady-state head solution reasonably matches the calibration target water levels." Please carefully explain how those levels are defined and where they are listed. Again, it is strongly suggested that the EPA guidelines attached below be used, including tables which show all the key parameters.*

    A table listing the calibration target water levels will be provided to DEQ and EPA during the model review process, and will be included in a report summarizing the model design and calibration.

11. *Appendix A SectionA.6.2. Where are the conditions that will be used for calibration (PT-1, PT-2, and PT-3 values need to be listed in report). What makes those values reasonable to use in this modeling calibration? The statement that these tests are considered representative of the ground water zone needs to be qualified by who reviewed those*

responses and who accepted them for use in this modeling. How do those values compare to other sites in the area? Were these values approved by ODEQ when the work was done? Are they considered acceptable for this modeling? The selected values should also be used as starting points, with some additional model runs which define sensitivity of the model to these parameters.

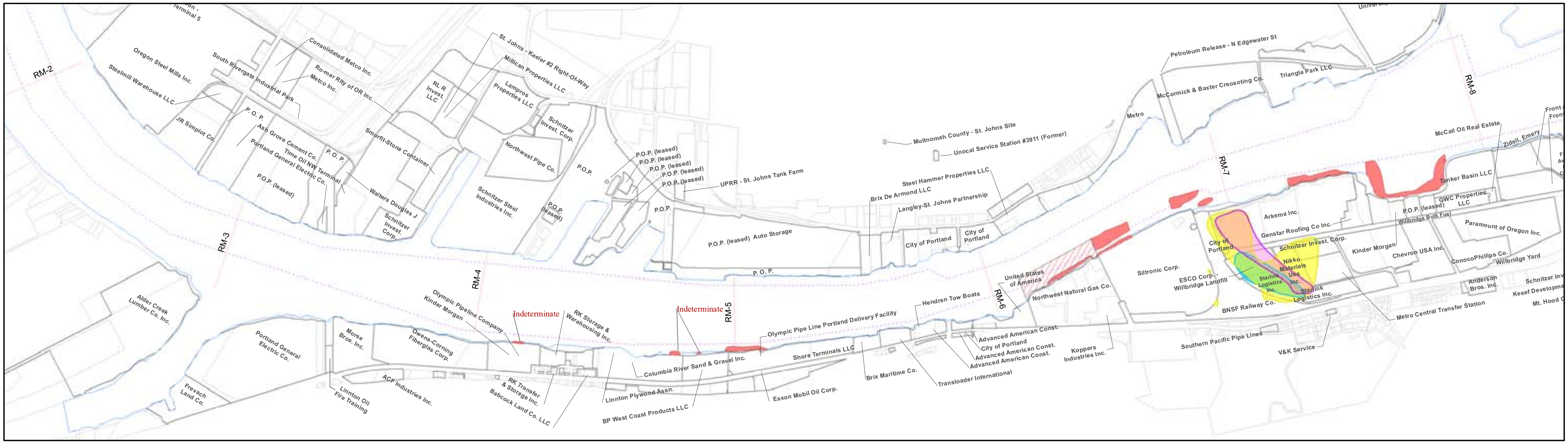
Pumping tests of PT-1, PT-2, and PT-3 were performed to obtain representative flow rates and hydraulic properties of the shallow aquifer at the Arkema site. These pumping tests were performed to determine the variation in response of the shallow aquifer to pumping conditions. Therefore, these pumping tests are both representative and appropriate for use in the model calibration. The pumping test procedures and the results of the tests were included in the *Arkema Active Pilot Test Workplan* prepared by GeoSyntec Consultants, which was approved by DEQ. The sensitivity of the model to various input parameters will be evaluated during model calibration.

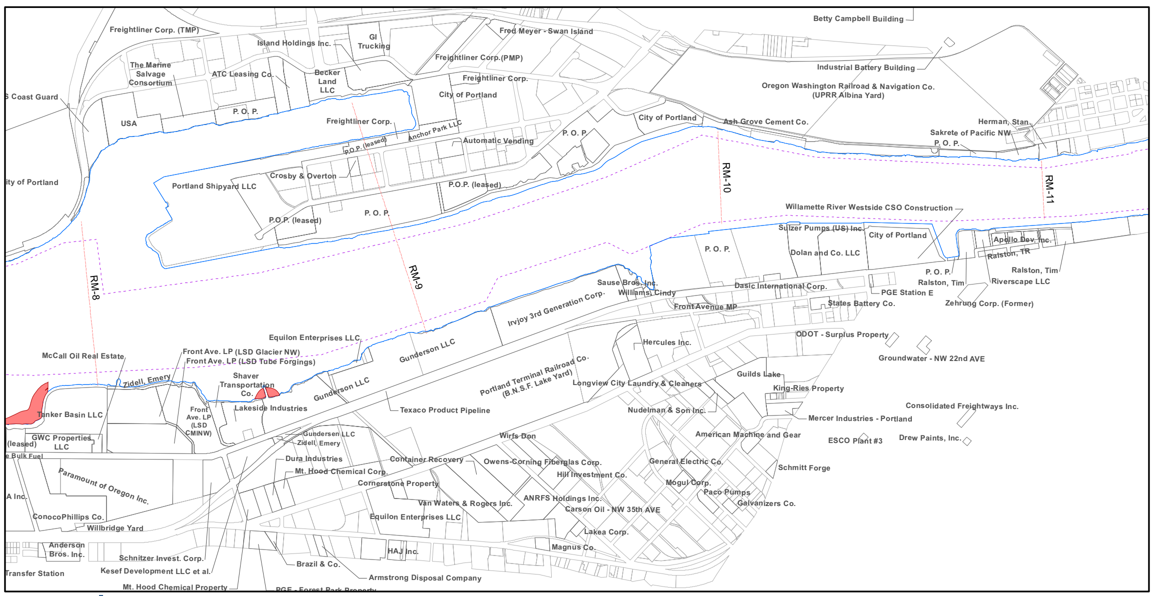
Sincerely,

Todd Slater
Legacy Site Services LLC

cc: Tom Grainger, DEQ NWR
Dan Hafley, DEQ NWR
Claudia Powers, Ater Wynne
Erik Ipsen, ERM
Larry Patterson, ERM
David Livermore, Integral
Sean Sheldrake, USEPA

Figures





Groundwater Plume Legend:

Dioxin Plumes

- deep
- intermediate
- shallow

Purple = deep & shallow
Green = intermediate and shallow
Orange = deep & intermediate

Potential Groundwater Plume Discharge Zones

- Interpreted Groundwater Discharge Zone
- Indeterminate Potential Groundwater Discharge Zone

Note: In-river groundwater discharge zones represent potential plume discharge areas for one or more of all COIs studied, and do not necessarily correspond to the upland plume analyte presented on the map.

Feature Legend:

- Navigation Channel
- River miles
- Site/Vicinity Tax Lot Owners
- Waterfront Taxlots

Map Document: (P:\Projects\Portland_Harbor\LWG-Map-Projects\Conceptual_Site_Model\GW_Plumes_2-panel_v3_ERS_011406.mxd)
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integral consulting inc.

LWG Lower Willamette Group

0 1,000 2,000 3,000 Feet

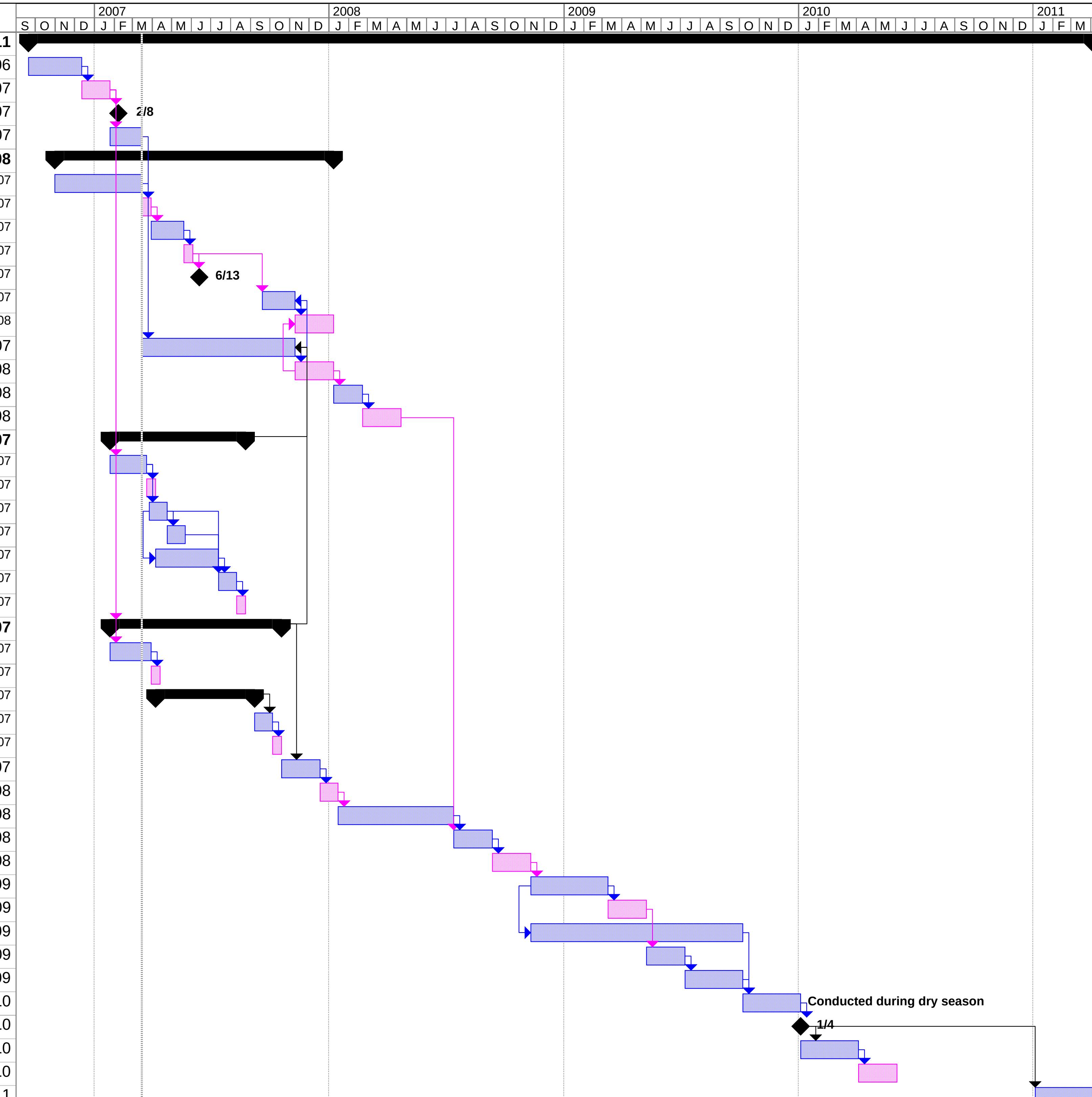
FEATURE SOURCES:
Transportation, Property, or Boundaries: Metro RLIS .
Channel & River miles: US Army Corps of Engineers.
Bathymetric Information: David Evans and Associates, Inc.

Map 5.1-1e
Portland Harbor RI/FS
Comprehensive Round 2 Report
Extent of Groundwater Impact, Dioxin

3/16/2007 Revision

Figure 4-2
REVISED DRAFT SCHEDULE

ID	Task Name	Duration	Start	Finish
1	**GROUNDWATER SOURCE CONTROL IRM**	**1657 days**	**Thu 9/21/06**	**Mon 4/4/11**
2	Scoping Technical Memorandum	83 days	Thu 9/21/06	Tue 12/12/06
3	Agency Review and Comment of Scoping Tech Memo	44 days	Wed 12/13/06	Thu 1/25/07
4	Conference Call to Discuss Agency Comments	0 days	Thu 2/8/07	Thu 2/8/07
5	Response to Agency Comments on Scoping Tech Memo	50 days	Fri 1/26/07	Fri 3/16/07
6	**Groundwater Modeling**	**434 days**	**Wed 11/1/06**	**Tue 1/8/08**
7	Stage 1 - Develop Model Framework	136 days	Wed 11/1/06	Fri 3/16/07
8	Agency Review of Model Framework	14 days	Sat 3/17/07	Fri 3/30/07
9	Stage 2 - Model Results and Calibration (GW Model Summary Report)	51 days	Sat 3/31/07	Sun 5/20/07
10	Agency Review of Groundwater Model Summary Report	14 days	Mon 5/21/07	Sun 6/3/07
11	Meeting to Discuss Agency Comments	0 days	Wed 6/13/07	Wed 6/13/07
12	Stage 3 - Simulations for Source Control Alternatives	51 days	Thu 9/20/07	Fri 11/9/07
13	Agency Review of Simulations for Source Control Alternatives	60 days	Sat 11/10/07	Tue 1/8/08
14	Focused Feasibility Study (FFS)	238 days	Sat 3/17/07	Fri 11/9/07
15	Agency Review and Comment on FFS	60 days	Sat 11/10/07	Tue 1/8/08
16	Revise and Resubmit FFS in response to comments	45 days	Wed 1/9/08	Fri 2/22/08
17	Agency Approval and Public Review Notice	60 days	Sat 2/23/08	Tue 4/22/08
18	**Geotechnical Evaluation and Slurry Compatibility Testing**	**211 days**	**Fri 1/26/07**	**Fri 8/24/07**
19	Scoping and Work Plan Preparation	57 days	Fri 1/26/07	Fri 3/23/07
20	Agency Review of Work Plan	14 days	Sat 3/24/07	Fri 4/6/07
21	Geotechnical Investigation	28 days	Wed 3/28/07	Tue 4/24/07
22	Geotechnical Engineering Evaluation	28 days	Wed 4/25/07	Tue 5/22/07
23	Slurry Compatibility Testing	98 days	Sat 4/7/07	Fri 7/13/07
24	Summary Report Preparation	28 days	Sat 7/14/07	Fri 8/10/07
25	Agency Review of Summary Report	14 days	Sat 8/11/07	Fri 8/24/07
26	**Groundwater Treatability Studies**	**267 days**	**Fri 1/26/07**	**Fri 10/19/07**
27	Scoping and Work Plan Preparation	64 days	Fri 1/26/07	Fri 3/30/07
28	Agency Review of Work Plan	14 days	Sat 3/31/07	Fri 4/13/07
29	Laboratory Groundwater Treatability Study	154 days	Sat 4/7/07	Fri 9/7/07
39	Summary Report Preparation	28 days	Sat 9/8/07	Fri 10/5/07
40	Agency Review of Summary Report	14 days	Sat 10/6/07	Fri 10/19/07
41	Groundwater Extraction and Treatment Pilot Study Work Plan	60 days	Sat 10/20/07	Tue 12/18/07
42	Agency Review of Pilot Study Work Plan	28 days	Wed 12/19/07	Tue 1/15/08
43	Groundwater Extraction and Treatment Pilot Study Performance	180 days	Wed 1/16/08	Sun 7/13/08
44	Draft Design Submittal	60 days	Mon 7/14/08	Thu 9/11/08
45	Agency Review of Draft Design	60 days	Fri 9/12/08	Mon 11/10/08
46	Pre-Final Design Submittal and Specifications	120 days	Tue 11/11/08	Tue 3/10/09
47	Agency Review and Approval of Pre-Final Design	60 days	Wed 3/11/09	Sat 5/9/09
48	Permitting	330 days	Tue 11/11/08	Tue 10/6/09
49	Final Design Submittal and Specifications	60 days	Sun 5/10/09	Wed 7/8/09
50	Procurement	90 days	Thu 7/9/09	Tue 10/6/09
51	Installation	90 days	Wed 10/7/09	Mon 1/4/10
52	Full System Startup	0 days	Mon 1/4/10	Mon 1/4/10
53	Groundwater Source Control Implementation Report	90 days	Tue 1/5/10	Sun 4/4/10
54	Agency Review and Approval of Source Control Implementation Report	60 days	Mon 4/5/10	Thu 6/3/10
55	Performance/Enhancement Evaluation	90 days	Wed 1/5/11	Mon 4/4/11



Project Schedule

Task | Agency Task | Milestone | Summary

Note: Dates and duration of tasks shaded in gray are dependent on timing of agency review.

2007-03-05_GW Source Control IRM Schedule_Rev.mpp